628.16
I.S61.l
1974

City ~~Plan. and Land. Arch.~~

ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY

LAKE MICHIGAN WATER QUALITY REPORT

1974

THE LIBRARY OF THE
OCT 1 7 1975
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Illinois
Richard H. Briceland, Director
Environmental Protection Agency
2200 Churchill Road, Springfield, Illinois 62706

Telephone: 217/782-3397

The Honorable Dan Walker
Governor, State of Illinois

Honorable Members of the 79th
General Assembly, State of Illinois

Gentlemen:

This Lake Michigan Water Quality Report summarizing the Agency's 1974 survey of this valuable Illinois resource is submitted for your information. Although improvement has been noted in certain lake areas as the new waste treatment discharge facilities are placed into operation, some of the report data indicates the persistence of significant problems.

Previous reports have identified specific problems including undesirable concentrations of polychlorinated biphenyls (PCBs) in fish flesh and high levels of ammonia, phosphorus and fecal coliform bacteria at many sampling stations, especially in the Lake County area. This 1974 survey report indicates that there has been no substantial change in fish flesh PCB concentrations but some water quality improvement has occurred at the Lake County area stations.

The importance of Lake Michigan as a natural resource for Illinois is well known. This Agency's program regarding the Lake reflects this importance through encouraging the elimination of wastewater discharges to the Lake, maintaining close surveillance over remaining discharges and Lake water quality, and by supporting and cooperating with other local, neighboring State and Federal groups who also work toward maintaining the Lake quality.

This survey is reported to you each year to provide an evaluation of the ecology and quality of the Lake Michigan waters serving Illinois. Additional copies of the report can be provided should you so request.

Sincerely,

Richard H. Briceland

TABLE OF CONTENTS

PAGE

List of Tables ii

List of Figures iii

Water Quality Monitoring

Beach and Water Plant Sampling 1

Turbidity 6
Temperature 9
pH 10
Ammonia Nitrogen (N). 10
Methylene Blue Active Substance (MBAS). 13
Chloride. 13
Cyanide 13
Fluoride. 15
Phenols 15
Sulfates. 17
Phosphorus (P). 17
Total Dissolved Solids (TDS). 20
Radioactivity 20
Fecal Coliform 23
Plankton. 23
Nitrate + Nitrite 26
Alkalinity. 26
Heavy Metals. 29
Hardness 32
Color 32
Chemical Oxygen Demand (COD). 32

Special Sampling

General Information. 37

Results of Monitoring

Pesticides, PCB's, and Phthalates in Water. 37
Pesticides and PCB's in Fish. 40

Illinois Discharges. 42

LIST OF TABLES

TABLE NUMBER PAGE

1 Beach locations sampled. 3

2 Location of raw water intakes monitored. 6

3 Turbidity recorded at the beaches and water plants. 7

4 Temperatures (monthly maximum) recorded at the beaches. . . . 8

5 Temperatures (monthly maximum) recorded at the water plants. . 9

6 pH recorded at the beaches and water plants. 11

7 Ammonia nitrogen (N) concentrations recorded at the beaches and water plants. 12

8 Chloride concentrations recorded at the beaches and water plants. 14

9 Fluoride concentrations recorded at the beaches and water plants. 16

10 Sulfate concentrations recorded at the beaches and water plants. 18

11 Total phosphorus (P) recorded at the beaches and water plants. 19

12 Total dissolved solids recorded at the beaches and water plants. 21

13 Radioactivity recorded at the beaches and water plants. . . . 22

14 Fecal coliform recorded at the beaches and water plants. . . . 24

15 Total plankton counts recorded at the beaches and water plants. 25

16 Nitrates + nitrites (N) recorded at the beaches and water plants. 27

17 Alkalinity recorded at the beaches and water plants. 28

18 Heavy metals recorded at the beaches. 30

19 Heavy metals recorded at the water plants. 31

20 Hardness recorded at the beaches and water plants. 33

LIST OF TABLES

TABLE NUMBER — PAGE

21 Color readings recorded at the beaches and water plants 34

22 Chemical oxygen demand (COD) recorded at the beaches and water plants 35

23 Pesticides, PCB's, and phthalates recorded at the sewage plants 38

24 Pesticides, PCB's and phthalates recorded at the streams 39

25 Pesticides and PCB's found in fish 41

LIST OF FIGURES

FIGURE NUMBER — PAGE

1 Location of North Shore beaches and facilities influencing their quality 4

2 Location of Chicago beaches and facilities influencing their quality 5

Acknowledgements

This report was prepared by the Region II Aquatic Biology Survey Unit of the Division of Water Pollution Control. The authors were Robert Schacht and Wallace Matsunaga. Graphics were provided by the Support Services Section. Sample analyses were performed by the Chicago, Champaign, and Springfield laboratories.

WATER QUALITY EVALUATION, 1973-1974

pH - Values continued to be within the standard. There was no significant change in values between the two years.

AMMONIA (N) - Values continued to frequently exceed the standard. Concentrations were significantly higher in 1974.

MBAS - Values were within the standard.

CHLORIDES - Values were generally within the standard.

CYANIDES - Values were generally within the standards.

FLUORIDES - Values continued to be generally within the standard. There was no significant change in values between the two years.

PHENOLS - Values continued to be within the standards.

SULFATES - Values continued to be within the standard.

PHOSPHORUS - Values continued to frequently exceed the standard. Shore water concentrations were significantly higher in 1974.

TOTAL DISSOLVED SOLIDS - In general, values continued to be witnin the standard. There was an increase in the number of individual samples exceeding the standard.

RADIONUCLIDES - Values continued to be within the standard.

FECAL COLIFORM - Coliform counts at the Lake County shore water stations showed localized improvement in 1974.

WATER QUALITY MONITORING

BEACH AND WATER PLANT SAMPLING

Lake Michigan serves a broad spectrum of purposes. It is the source of drinking water for 5 million residents of northeastern Illinois. Its recreational opportunities attract fishing, boating, swimming and other water-oriented interests. It is the avenue for domestic and international water-borne commerce. Its readily available water for industry and commerce encouraged the growth and development of the greater Chicago metropolitan area into one of the largest industrial-commercial complexes in the United States. Ironically, Lake Michigan has also been the recipient of municipal and industrial wastes throughout its watershed.

Discharges from industrial complexes located along the southwestern shore of Lake Michigan affect the quality of Illinois waters. These discharges, consisting of process, cooling, dilution and other waste waters, have adverse effects on the local environment as well as the total ecology of the lake. Inadequately treated sewage effluents, bypasses from overloaded sewage treatment facilities and combined sewer overflows contribute to the lake's organic enrichment. The aging or eutrophication of Lake Michigan is accelerated by the addition of nutrients from both industrial and municipal discharges. While the number of discharges in Illinois are few and have little impact on the overall quality of Lake Michigan, local problems have resulted in the closing of beaches in Lake County.

In addition to man-made inputs to Lake Michigan, lake water quality is also affected by natural phenomena. During most of the year, from about April to November, the lake is thermally stratified. The formation of thermoclines during this period prevents the free exchange of dissolved oxygen between these layers and results in the reduction of dissolved oxygen near the lake bottom. Stratification is destroyed during late fall and spring overturns. Mixing occurs between the surface and bottom waters during these overturns resulting in some resuspension of settled bottom deposits. At these times, there are noticeable and measurable increases in turbidity, color and mineral concentrations.

Lake currents also influence water quality. Effluents may be carried a considerable distance from the point of discharge through physical transport or may remain near the point of discharge. In these areas of influence sludge-like deposits may accumulate on the lake bottom and be colonized by aquatic organisms able to tolerate the altered habitats.

Tributary streams and rivers add to the sediment and nutrient levels of the lake. As these waters flow downstream, sediments, nutrients, fertilizers, pesticides and other substances are acquired through erosion, land runoff, and from industrial and municipal waste discharges.

Climatic factors, too, exert their influence on lake water quality. Increases in bacteria counts, suspended and dissolved solids and organic and nutrient levels can be expected following a storm and resulting storm water runoff.

Recognizing the importance of Lake Michigan as a natural asset, the Illinois 75th General Assembly authorized the Environmental Protection Agency to ".... regularly conduct water quality and lake bed surveys to evaluate the ecology and the quality of water in Lake Michigan." Pursuant to this mandate the State of Illinois conducts an on-going program of water quality monitoring in Lake Michigan.

The monitoring program has provided information on the condition of the Illinois waters of Lake Michigan. As data is gathered on a continuing basis, it should be possible to determine long term trends in lake water quality.

Lake water quality has been evaluated on the basis of the water quality standards promulgated by the Illinois Pollution Control Board. Three categories of standards are in force in Illinois depending on the use (s) to be made of the particular body of water. The General Standards are designed to "....... protect the State's water for aquatic life, agricultural use, primary and secondary contact use, and most industrial uses, and ensure the aesthetic quality of the State's aquatic environment." Waters used as sources of potable water and for food processing must, in addition to meeting the General Standards, meet the more stringent Public and Food Processing Water Supply Standards. Additionally, critical parameters were designated as part of the Lake Michigan Standards. Lake waters, in addition to meeting the General and Public and Food Processing Water Supply Standards, must meet the strict standards for:

pH
Ammonia Nitrogen
Chloride
Sulfate
Phosphorus
Total Dissolved Solids
Fecal Coliform
Temperature

In this report the shore and offshore data were evaluated on the basis of the Lake Michigan standards for the above parameters. Standards applicable to the Public and Food Processing Water Supply were used to evaluate those offshore parameters not specifically covered by the Lake Michigan standard. Shore water quality, which is adversely affected by waste discharges, land runoff, and storms to a much greater extent than offshore water, was evaluated on the basis of the General Standards for those parameters not part of the Lake Michigan Standards.

Data on lake water quality were obtained from shore waters and municipal water filtration plants. All samples were delivered to the Chicago Laboratory of the Illinois Environmental Protection Agency within six hours of collection. The cyanide, phenol, ammonia and metals samples were treated with preservatives to retard any chemical or biological alteration of their composition. Samples for bacterial analysis were collected in sterilized bottles and put on ice prior to delivery to the laboratory. Plankton samples were preserved with a formalin solution.

Shore Water Sampling

The twenty-six beaches listed below were the shore water sampling stations during 1974 (Figures 1 and 2). Samples were collected twice per month, with a total number of 14 samplings at each station. Samples were collected just below the surface in approximately 2½ feet of water. The shore water sampling season extended from April 10 to October 21, 1974.

Table 1. Beach locations sampled in 1974.

Winthrop Harbor - Main Street
Ill. Beach State Park
Zion - Route 173
Waukegan - North
Waukegan - Central
North Chicago - Foss Park
Lake Bluff - Center Avenue
Lake Forest - Westminster Avenue
Highwood - Walker Avenue
Highland Park - Park Avenue
Highland Park - Ravine Drive
Highland Park - Cary Avenue
Glencoe - Park Avenue
Winnetka - Lloyd Park
Kenilworth - Kenilworth Avenue
Wilmette - Lake Avenue
Evanston - Dempster Street
Chicago - Touhy Avenue
Chicago - Bryn Mawr Avenue
Chicago - Montrose Avenue
Chicago - North Avenue
Chicago - Roosevelt Road
Chicago - 31st Street
Chicago - 63rd Street
Chicago - 76th Street
Chicago - 100th Street

Offshore Water Sampling

Lake samples for monitoring offshore or "open" water quality were obtained at the intakes of five municipal water filtration plants utilizing Lake Michigan as their source of water supply.

Raw water samples were collected twice monthly at the Zion-Benton, Highland Park, Evanston, Chicago Central and Chicago South water plants. The number of intakes and distance from shore is presented in Table 2.

Figure 1. Locations of North Shore beaches and facilities influencing their quality.

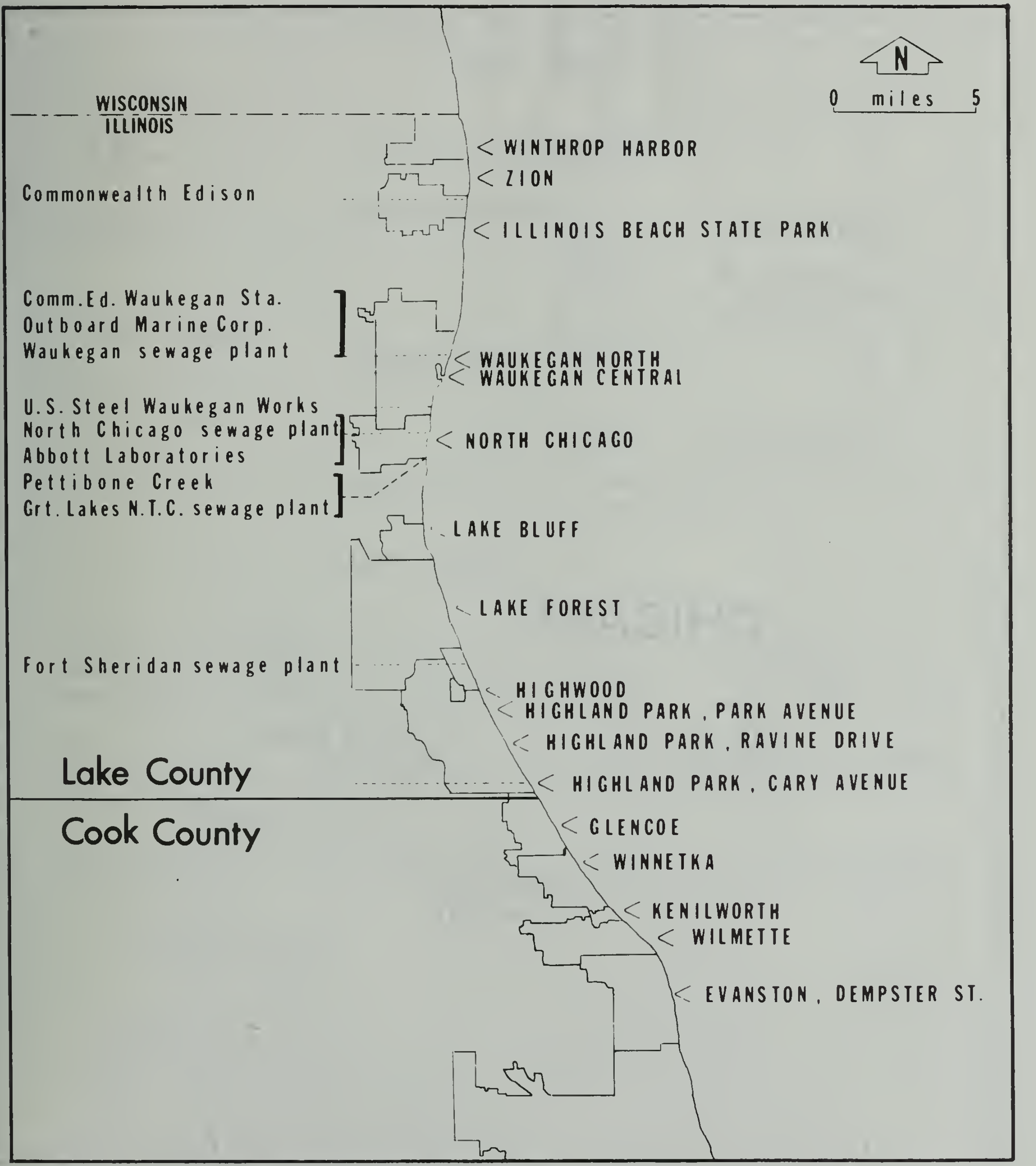

Figure 2. Locations of Chicago beaches and facilities influencing their quality.

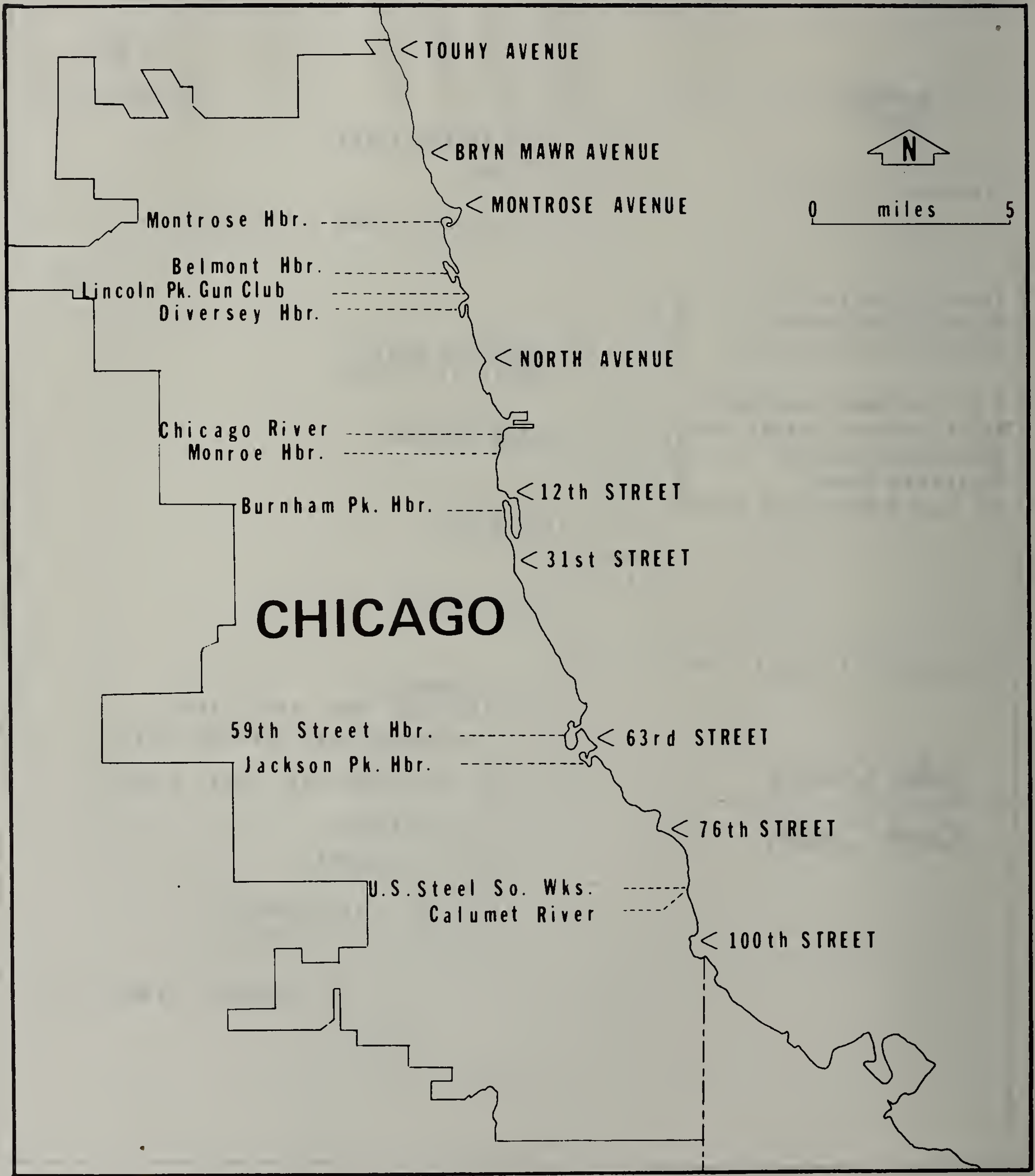

Table 2. Location of raw water intakes monitored at municipal water filtration plants in 1974.

Name of Plant	Number of Intakes	Distance of Intake from Shore (ft.)	Depth drawn from (ft.)
Zion-Benton	1	2,700	37
Highland Park	3	1,000	9
		2,000	20
		3,500	28
Evanston	3	1,800	16
		2,600	18
		5,600	28
Chicago Central	2	Shore	20
		13,000	35
Chicago South	2	Shore	24
		12,100	32

TURBIDITY

Turbidity is a measure of the extent to which light penetration in water is diminished by the presence of suspended and colloidal matter. Measurement of turbidity is expressed in turbidity units (TU).

Beach turbidities ranged from 1 to 195 TU. Averages by station ranged from 5 to 41 TU, and the average of all samples was 21 TU (Table 3). Highest levels were recorded at the Highland Park beaches.

Water plant turbidities ranged from 1 to 52 TU. Averages by station ranged from 4 to 15 TU, and the average of all samples was 9 TU.

Table 3. Turbidity levels recorded at Lake Michigan beaches and water plants in 1974. Values are expressed in turbidity units (TU).

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	14	1 - 54	15
Zion	14	1 - 62	19
Illinois Beach State Pk.	14	1 - 66	24
Waukegan North	14	1 - 39	13
Waukegan Central	14	1 - 44	17
North Chicago	13	1 - 84	23
Lake Bluff	14	1 - 160	32
Lake Forest	14	1 - 125	29
Highwood	14	1 - 175	39
Highland Park-Park Ave.	14	2 - 195	41
Highland Park-Ravine Dr.	13	2 - 160	38
Highland Park-Cary Ave.	14	2 - 140	33
Glencoe	14	1 - 155	29
Winnetka	14	1 - 160	28
Kenilworth	14	1 - 150	27
Wilmette	14	1 - 140	27
Evanston	14	1 - 100	20
Chicago-Touhy Ave.	14	1 - 96	20
Chicago-Bryn Mawr Ave.	14	1 - 93	19
Chicago-Montrose Ave.	14	1 - 70	17
Chicago-North Ave.	14	1 - 36	12
Chicago-12th Street	14	1 - 20	7
Chicago-31st Street	14	1 - 20	7
Chicago-63rd Street	14	1 - 21	8
Chicago-76th Street	14	1 - 35	9
Chicago-100th Street	14	1 - 20	5
Water Plants			
Zion-Benton	17	2 - 33	9
Highland Park	19	1 - 52	14
Evanston	20	1 - 44	15
Chicago Central	20	1 - 15	4
Chicago South	19	1 - 15	4

expressed in degrees Fahrenheit.

Standard: Maximum	55°	60°	70°	80°	80°	80°	65°
Sampling Location	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.
Winthrop Harbor	48	50	58	63	54	59	51
Zion	48	51	59	63	54	55	51
Illinois Beach State Park	49	52	58	63	53	54	53
Waukegan North	49	60	61	70	68	64	58
Waukegan Central	49	60	65	75	64	71	54
North Chicago	50	55	60	65	56	63	57
Lake Bluff	51	57	56	66	60	65	53
Lake Forest	50	57	56	63	63	65	55
Highwood	50	57	56	67	65	65	54
Highland Park-Park Ave.	50	58	--	67	65	65	54
Highland Park-Ravine Dr.	50	57	55	62	66	66	54
Highland Park-Cary Ave.	49	57	59	68	66	66	54
Glencoe	55	52	57	63	67	67	50
Winnetka	55	52	62	63	70	70	50
Kenilworth	55	52	57	63	70	68	50
Wilmette	55	54	56	65	69	69	50
Evanston	54	52	57	66	67	68	50
Chicago-Touhy Ave.	54	52	59	68	67	68	50
Chicago-Bryn Mawr Ave.	54	54	62	67	70	72	50
Chicago-Montrose Ave.	54	54	59	66	67	68	51
Chicago-North Ave.	55	54	59	66	67	67	50
Chicago-12th Street	54	55	60	70	73	67	54
Chicago-31st Street	54	54	60	69	71	67	54
Chicago-63rd Street	55	54	59	68	74	67	54
Chicago-76th Street	54	54	59	68	70	66	54
Chicago-100th Street	54	56	61	71	71	68	55

TEMPERATURE

Temperature is a controlling factor in the aquatic environment. It affects the oxygen carrying capacity of a body of water, rates of biochemical reactions, and the spawning, hatching, growth and migration of aquatic organisms.

Because heated discharges may disrupt aquatic ecosystems, all sources of heated effluents, outside of a defined mixing zone, may not raise the ambient temperatures above the monthly maximums listed in Table 5.

Beach temperatures did not exceed the monthly limits although April and May temperatures at several stations reached the monthly limits of 55°F. and 60°F., respectively (Table 4).

Water plant temperatures were within the monthly maximums at all five water plants in 1974 (Table 5).

Table 5. Maximum monthly temperatures recorded at five municipal water filtration plants in 1974. Values are expressed in degrees Fahrenheit.

Standard: Maximum	45°	45°	45°	55°	60°	70°	80°	80°	80°	65°	60°	50°
Sampling Location	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Zion-Benton	34	----	42	46	52	54	55	50	56	52	----	39
Highland Park	35	35	42	49	56	54	60	60	63	55	45	41
Evanston	35	36	42	51	52	56	61	65	66	57	47	41
Chicago Central	37	38	42	50	53	58	63	62	68	58	47	42
Chicago South	35	36	41	50	55	59	67	67	67	58	46	41

pH

pH is the logarithm of the reciprocal of the hydrogen ion concentration. In practice, it is the measurement of the concentration of hydrogen ions. By definition, the pH range is from 0, which is very acidic, to 14, which is very alkaline. Since the concentration of hydrogen ions regulates the degree of dissociation of many substances, pH may be a significant factor in determining limiting threshold concentrations in natural waters. Abnormal fluctuations in pH may be an indication of industrial waste discharges.

During the year, 362 pH analyses were performed on samples obtained from the beach stations. All values were within the range of 7.8 to 8.6. Median values were 8.3 at the Lake Bluff, Lake Forest, and Highwood beaches, and 8.2 for the other beaches. The median of all samples was 8.2 (Table 6).

pH values at the water plants ranged from 7.8 to 8.7. Median values ranged from 8.1 to 8.3, and the median of all samples was 8.2.

AMMONIA NITROGEN (as N)

Ammonia nitrogen is one of the compounds resulting from the metabolic activity of living organisms. It may be present in surface waters as a result of agricultural runoff, certain industrial wastes, and runoff from pastures or feedlots. It is a component of sewage, and relatively high concentrations may be found in the effluents of sewage treatment facilities.

Excessive concentrations of ammonia nitrogen were found at all beach stations. Maximum values ranged from 0.23 to 4.10 mg/l. The highest concentrations were found at the Waukegan North beach, where seven of the 14 samples had concentrations in excess of 1.00 mg/l. The average of all samples was 0.20 mg/l. Concentrations higher than 0.02 mg/l constituted 97% of the Lake County and 94% of the Cook County samples. Significantly higher average ammonia nitrogen levels were present at the Lake County stations. Although both counties showed a high percentage of samples in excess of the standard, the Lake County average of 0.27 mg/l was twice the 0.13 mg/l average of the Cook County stations (Table 7).

Samples at the water plants yielded excessive concentrations of ammonia nitrogen. Maximum values ranged from 0.25 to 0.65 mg/l. The average of all plants was 0.12 mg/l. Values greater than 0.02 mg/l were found in 89 to 100% of the samples by plant. Overall, 94% of the samples exceeded the standard.

Table 6. pH values at Lake Michigan beaches and water plants in 1974. Values are expressed in pH units.

Standard: 7.0 - 9.0

Sampling Location	Samples Analyzed	Range	Median
Beaches			
Winthrop Harbor	14	7.8 - 8.4	8.2
Zion	14	8.0 - 8.5	8.2
Illinois Beach State Park	14	7.9 - 8.5	8.2
Waukegan North	14	8.0 - 8.5	8.2
Waukegan Central	14	8.0 - 8.5	8.2
North Chicago	13	7.8 - 8.5	8.2
Lake Bluff	14	7.9 - 8.6	8.3
Lake Forest	14	7.9 - 8.5	8.3
Highwood	14	8.0 - 8.6	8.3
Highland Park-Park Ave.	14	7.8 - 8.6	8.2
Highland Park-Ravine Dr.	13	7.9 - 8.6	8.2
Highland Park-Cary Ave.	14	8.0 - 8.5	8.2
Glencoe	14	8.0 - 8.4	8.2
Winnetka	14	8.0 - 8.6	8.2
Kenilworth	14	8.0 - 8.5	8.2
Wilmette	14	8.0 - 8.6	8.2
Evanston	14	8.1 - 8.6	8.2
Chicago-Touhy Ave.	14	7.9 - 8.6	8.2
Chicago-Bryn Mawr Ave.	14	7.9 - 8.6	8.2
Chicago-Montrose Ave.	14	8.0 - 8.5	8.2
Chicago-North Ave.	14	8.0 - 8.5	8.2
Chicago-12th Street	14	8.0 - 8.5	8.2
Chicago-31st Street	14	8.1 - 8.5	8.2
Chicago-63rd Street	14	8.1 - 8.6	8.2
Chicago-76th Street	14	8.1 - 8.6	8.2
Chicago-100th Street	14	8.0 - 8.5	8.2
Water Plants			
Zion-Benton	17	8.0 - 8.6	8.1
Highland Park	19	8.0 - 8.6	8.3
Evanston	20	7.8 - 8.7	8.2
Chicago Central	20	8.0 - 8.6	8.2
Chicago South	19	7.9 - 8.8	8.2

Table 7. Ammonia nitrogen (as N) concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 0.02 mg/l

Sampling Location	Range	Average Concentration	Number of Samples Exceeding Standard
Beaches			
Winthrop Harbor	0.00 - 0.25	0.12	12 of 14
Zion	0.00 - 0.25	0.12	13 of 14
Illinois Beach State Park	0.00 - 0.34	0.14	13 of 14
Waukegan North	0.03 - 4.10	1.58	14 of 14
Waukegan Central	0.05 - 0.80	0.26	14 of 14
North Chicago	0.05 - 0.60	0.22	13 of 13
Lake Bluff	0.03 - 0.29	0.13	14 of 14
Lake Forest	0.03 - 0.23	0.12	14 of 14
Highwood	0.02 - 0.28	0.11	13 of 14
Highland Park-Park Ave.	0.05 - 0.32	0.14	14 of 14
Highland Park-Ravine Dr.	0.05 - 0.25	0.12	13 of 13
Highland Park-Cary Ave.	0.03 - 0.50	0.16	14 of 14
Glencoe	0.03 - 0.40	0.16	14 of 14
Winnetka	0.04 - 0.24	0.12	14 of 14
Kenilworth	0.02 - 0.26	0.11	13 of 14
Wilmette	0.04 - 0.23	0.12	14 of 14
Evanston	0.00 - 1.20	0.18	13 of 14
Chicago-Touhy Ave.	0.00 - 0.40	0.13	13 of 14
Chicago-Bryn Mawr Ave.	0.00 - 0.30	0.13	12 of 14
Chicago-Montrose Ave.	0.00 - 0.50	0.13	13 of 14
Chicago-North Ave.	0.04 - 0.42	0.14	14 of 14
Chicago-12th Street	0.00 - 0.30	0.12	12 of 14
Chicago-31st Street	0.04 - 0.25	0.11	13 of 13
Chicago-63rd Street	0.01 - 0.37	0.12	13 of 14
Chicago-76th Street	0.02 - 0.23	0.11	13 of 14
Chicago-100th Street	0.00 - 0.41	0.16	13 of 14
Water Plants			
Zion-Benton	0.00 - 0.30	0.14	16 of 17
Highland Park	0.03 - 0.25	0.11	19 of 19
Evanston	0.02 - 0.65	0.13	19 of 20
Chicago Central	0.00 - 0.28	0.12	18 of 20
Chicago South	0.00 - 0.24	0.11	17 of 19

METHYLENE BLUE ACTIVE SUBSTANCE (MBAS)

Methylene blue active substance is a component of synthetic detergents and is introduced into the aquatic environment primarily via the effluents of sewage treatment plants.

Beach MBAS concentrations ranged from 0.00 to 0.40 mg/l. The permissible limit, which is based on the Public Water Supply Standard, is 0.50 mg/l. Approximately 90% of the values were 0.10 mg/l or less, and 98% were 0.20 mg/l or less.

Water plant MBAS concentrations ranged from 0.00 to 0.20 mg/l. Of these, 82% represented values of 0.10 mg/l or less.

CHLORIDE

Chlorides are one of the most common chemical constituents found in surface waters and are continually entering Lake Michigan through natural processes. Certain industrial wastes may be significant contributors. Ferric chloride is being used at several of the sewage treatment plants tributary to Lake Michigan to reduce phosphorus levels in their effluents.

The highest chloride concentrations at the beaches ranged from 10 to 63 mg/l. Lake and Cook County averages were 11 and 9 mg/l, respectively, and the average of all samples was 10 mg/l. Samples with concentrations higher than the 12 mg/l standard constituted 18% of the Lake County samples and 1% of the samples from Cook County (Table 8).

The highest concentrations at the water plants ranged from 11 to 14 mg/l. The average of 95 samples was 9 mg/l.

CYANIDE

Cyanide is a toxic compound present in the waste discharges from gas works, coke ovens, metal cleaning and electroplating processes, scrub waters from steel mills, and from chemical industries.

Measurable concentrations were found in three of 180 beach samples. These samples, with concentrations of 0.020, 0.050, and 0.060 mg/l, were collected at the Waukegan North beach. The two higher values exceeded the 0.025 mg/l standard.

Measurable concentrations of cyanide were not found in 58 water plant samples.

Table 8. Chloride concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 12 mg/l

Sampling Location	Range	Average Concentration	Number of Samples Exceeding Standard
Beaches			
Winthrop Harbor	8-17	10	2 of 14
Zion	8-18	10	1 of 14
Illinois Beach State Park	8-16	10	1 of 14
Waukegan North	8-31	15	8 of 14
Waukegan Central	8-17	10	3 of 14
North Chicago	8-17	12	5 of 13
Lake Bluff	8-63	13	1 of 14
Lake Forest	8-15	10	1 of 14
Highwood	8-16	10	1 of 14
Highland Park-Park Ave.	8-14	10	2 of 14
Highland Park-Ravine Dr.	8-38	12	3 of 13
Highland Park-Cary Ave.	8-30	11	2 of 14
Glencoe	8-13	10	2 of 14
Winnetka	8-12	9	0 of 14
Kenilworth	8-11	9	0 of 14
Wilmette	8-11	9	0 of 14
Evanston	8-10	9	0 of 14
Chicago-Touhy Ave.	8-11	9	0 of 14
Chicago-Bryn Mawr Ave.	8-11	9	0 of 14
Chicago-Montrose Ave.	8-11	9	0 of 14
Chicago-North Ave.	8-12	9	0 of 14
Chicago-12th Street	8-11	9	0 of 14
Chicago-31st Street	8-11	9	0 of 14
Chicago-63rd Street	8-12	9	0 of 14
Chicago-76th Street	8-10	9	0 of 14
Chicago-100th Street	9-11	10	0 of 14
Water Plants			
Zion-Benton	8-12	9	0 of 17
Highland Park	8-12	9	0 of 19
Evanston	8-14	9	1 of 20
Chicago Central	8-11	9	0 of 20
Chicago South	8-11	9	0 of 19

FLUORIDES

Fluorides are used in the manufacturing of steel, glass and enamel, insecticide preparations, and have disinfecting and preserving applications. At lower concentrations, fluorides in drinking water reduce the incidence of dental caries. At higher concentrations toxic properties are exhibited.

Fluoride concentrations at the beaches ranged from 0.1 to 0.4 mg/l. The average of all samples was 0.1 mg/l (Table 9).

The water plants exhibited similar concentrations of fluoride. Concentrations ranged from 0.1 to 0.9 mg/l, and the average of all samples was 0.1 mg/l.

PHENOL

Phenols are associated with industrial wastes from coal distillation processes and the manufacture of plastics, dyes and disinfectants. In relatively small concentrations, they can cause taste and odor problems in public water supplies.

Measurable concentrations of phenols were recorded in 12 of 350 beach samples. These values ranged from 0.005 to 0.760 mg/l. Single values of 0.011, 0.008 and 0.005 mg/l were found at the Waukegan Central, North Chicago and Highland Park Ravine Drive beaches, respectively. The remaining nine samples, including four that exceeded the General Standard of 0.100 mg/l, were from the Waukegan North beach. These concentrations in mg/l were:

0.005
0.010
0.013
0.052
0.070
0.147
0.260
0.310
0.760

At the water plants measurable concentrations of phenols were not found in 95 samples.

Table 9. Fluoride concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 1.4 mg/l

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	14	0.1 - 0.2	0.1
Zion	14	0.1 - 0.2	0.1
Illinois Beach State Park	14	0.1 - 0.2	0.1
Waukegan North	14	0.1 - 0.4	0.2
Waukegan Central	14	0.1 - 0.2	0.1
North Chicago	13	0.1 - 0.2	0.1
Lake Bluff	14	0.1 - 0.2	0.1
Lake Forest	14	0.1 - 0.2	0.1
Highwood	14	0.1 - 0.1	0.1
Highland Park-Park Ave.	14	0.1 - 0.2	0.1
Highland Park-Ravine Dr.	13	0.1 - 0.3	0.1
Highland Park-Cary Ave.	14	0.1 - 0.1	0.1
Glencoe	14	0.1 - 0.1	0.1
Winnetka	14	0.1 - 0.2	0.1
Kenilworth	14	0.1 - 0.1	0.1
Wilmette	14	0.1 - 0.1	0.1
Evanston	14	0.1 - 0.1	0.1
Chicago-Touhy Ave.	14	0.1 - 0.1	0.1
Chicago-Bryn Mawr Ave.	14	0.1 - 0.1	0.1
Chicago-Montrose Ave.	14	0.1 - 0.2	0.1
Chicago-North Ave.	14	0.1 - 0.2	0.1
Chicago-12th Street	14	0.1 - 0.2	0.1
Chicago-31st Street	14	0.1 - 0.2	0.1
Chicago-63rd Street	14	0.1 - 0.2	0.1
Chicago-76th Street	14	0.1 - 0.2	0.1
Chicago-100th Street	14	0.1 - 0.2	0.1
Water Plants			
Zion-Benton	17	0.1 - 0.2	0.1
Highland Park	19	0.1 - 0.2	0.1
Evanston	20	0.1 - 0.2	0.1
Chicago Central	20	0.1 - 0.2	0.1
Chicago South	19	0.1 - 0.9	0.2

SULFATE

Sulfate is a component of natural bodies of water. Abnormal fluctuations in background levels may be the result of industrial waste discharges. In drinking water supplies, high sulfate concentrations may have a cathartic effect.

The maximum sulfate concentrations at the beaches ranged from 20 to 53 mg/l, and the average of all samples was 20 mg/l. Average concentrations by county were 21 and 20 mg/l, respectively, for the Lake and Cook County stations. Excessive sulfate levels were found in 13% of the Lake County samples (Table 10).

At the water plants the maximum sulfate concentrations ranged from 21 to 23 mg/l. The average of all samples was 19 mg/l.

TOTAL PHOSPHORUS (as P)

Phosphorus is found in domestic sewage, some industrial wastes and in drainage from agricultural areas. It is considered to be one of the nutrients responsible for excessive algae growth. An effluent standard for waste discharges to Lake Michigan has resulted in the interim use of chemicals to reduce the phosphorus content of sewage plant effluents.

Maximum phosphorus concentrations at the beaches ranged from 0.060 to 1.400 mg/l. Individual beach averages ranged from 0.026 to 0.158 mg/l. The average of all samples was 0.068 mg/l. Ninety-eight percent of the Lake and 95% of the Cook County samples were found to have concentrations above the 0.007 mg/l standard. Although each county showed similar percentages of samples with excessive concentrations, the Lake County average of 0.094 mg/l was double the Cook County average of 0.046 mg/l (Table 11).

At the water plants the maximum concentrations ranged from 0.060 to 0.370 mg/l. Averages by station ranged from 0.014 to 0.044 mg/l, and the average of all samples was 0.029 mg/l. Concentrations higher than 0.007 mg/l were found in 76% of the samples.

Table 10. Sulfate concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 24 mg/l

Sampling Location	Range	Average Concentration	Number of Samples Exceeding Standard
Beaches			
Winthrop Harbor	17-25	20	1 of 14
Zion	17-26	20	1 of 14
Illinois Beach State Park	16-24	20	0 of 14
Waukegan North	17-53	29	8 of 14
Waukegan Central	17-35	21	2 of 14
North Chicago	19-32	24	5 of 12
Lake Bluff	17-24	20	0 of 14
Lake Forest	15-31	20	1 of 14
Highwood	16-27	20	2 of 14
Highland Park-Park Ave.	17-22	20	0 of 14
Highland Park-Ravine Dr.	16-50	22	1 of 14
Highland Park-Cary Ave.	16-22	19	0 of 14
Glencoe	15-23	20	0 of 14
Winnetka	17-22	20	0 of 14
Kenilworth	16-22	19	0 of 14
Wilmette	16-21	20	0 of 14
Evanston	16-22	19	0 of 14
Chicago-Touhy Ave.	17-20	19	0 of 14
Chicago-Bryn Mawr Ave.	15-21	19	0 of 14
Chicago-Montrose Ave.	16-21	19	0 of 14
Chicago-North Ave.	17-21	19	0 of 14
Chicago-12th Street	17-23	20	0 of 14
Chicago-31st Street	17-22	20	0 of 14
Chicago-63rd Street	17-22	19	0 of 14
Chicago-76th Street	17-21	20	0 of 14
Chicago-100th Street	18-22	20	0 of 14
Water Plants			
Zion-Benton	16-22	19	0 of 17
Highland Park	16-23	19	0 of 19
Evanston	16-22	19	0 of 20
Chicago Central	17-21	19	0 of 20
Chicago South	17-21	19	0 of 19

Table 11. Total phosphorus concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 0.007 mg/l

Sampling Location	Range	Average Concentration	Number of Samples Exceeding Standard
Beaches			
Winthrop Harbor	0.007 - 0.280	0.061	13 of 14
Zion	0.000 - 0.200	0.066	13 of 14
Illinois Beach State Park	0.021 - 0.190	0.073	14 of 14
Waukegan North	0.020 - 0.510	0.111	14 of 14
Waukegan Central	0.000 - 0.420	0.094	13 of 14
North Chicago	0.019 - 0.300	0.103	13 of 13
Lake Bluff	0.000 - 0.230	0.060	13 of 14
Lake Forest	0.020 - 1.400	0.158	14 of 14
Highwood	0.015 - 0.310	0.104	14 of 14
Highland Park-Park Ave.	0.030 - 0.360	0.142	14 of 14
Highland Park-Ravine Dr.	0.013 - 0.450	0.100	13 of 13
Highland Park-Cary Ave.	0.015 - 0.160	0.057	14 of 14
Glencoe	0.027 - 0.200	0.059	14 of 14
Winnetka	0.008 - 0.200	0.056	14 of 14
Kenilworth	0.011 - 0.180	0.054	14 of 14
Wilmette	0.013 - 0.160	0.059	14 of 14
Evanston	0.000 - 0.190	0.050	13 of 14
Chicago-Touhy Ave.	0.000 - 0.160	0.052	13 of 14
Chicago-Bryn Mawr Ave.	0.000 - 0.140	0.054	13 of 14
Chicago-Montrose Ave.	0.000 - 0.150	0.054	13 of 14
Chicago-North Ave.	0.000 - 0.110	0.043	13 of 14
Chicago-12th Street	0.000 - 0.080	0.026	13 of 14
Chicago-31st Street	0.020 - 0.080	0.036	14 of 14
Chicago-63rd Street	0.000 - 0.060	0.031	13 of 14
Chicago-76th Street	0.005 - 0.070	0.032	13 of 14
Chicago-100th Street	0.000 - 0.070	0.031	12 of 14
Water Plants			
Zion-Benton	0.000 - 0.370	0.044	13 of 17
Highland Park	0.002 - 0.140	0.041	18 of 19
Evanston	0.000 - 0.110	0.033	17 of 20
Chicago Central	0.000 - 0.070	0.015	13 of 20
Chicago South	0.000 - 0.060	0.014	11 of 19

TOTAL DISSOLVED SOLIDS

Dissolved solids in high concentrations are undesirable in drinking water supplies because of their possible laxative and unpalatable taste properties. In the aquatic ecosystem they provide essential nutrients in productivity cycles. At very high concentrations they may exert osmotic or toxic stresses on fish and other aquatic life.

Concentrations of total dissolved solids at the beaches ranged from 170 to 320 mg/l. Excessive concentrations occurred most often at the Waukegan North and North Chicago beaches where more than half of the samples were found to have values higher than 180 mg/l. The average of all samples was 180 mg/l. In 1974, 23% of the Lake County and 9% of the Cook County samples contained concentrations higher than the 180 mg/l standard (Table 12).

Concentrations of total dissolved solids at the water plants ranged from 170 to 230 mg/l with an average of 180 mg/l. Fifteen percent of the 95 samples exceeded the standard.

RADIOACTIVITY

In addition to naturally occurring background radiation, radioactive substances may enter the aquatic environment via several pathways. These substances may enter bodies of water as discharges from atomic energy installations, from users of radionuclides, through the activities associated with uranium ore mining and as atmospheric fall-out. There is no standard for gross alpha emissions. Gross beta values may not be higher than 100 pCi/l.

The maximum gross alpha values at the beaches ranged from 0.2 to 2.6 pCi/l. Averages by station ranged from 0.0 to 0.6 pCi/l, and the average of all pCi/l samples was 0.3 pCi/l. The maximum gross beta values were well below 100 pCi/l, ranging in maximum values from 3.7 to 13.3 pCi/l by station. Individual station averages were between 2.8 and 5.1 pCi/l, and the average of all samples was 4.0 pCi/l (Table 13).

At the water plants the maximum gross alpha values ranged from 0.6 to 1.5 pCi/l. Gross beta averages by plant ranged from 3.4 to 4.0 pCi/l, and the average of all samples was 3.6 pCi/l.

Table 12. Total dissolved solids (TDS) concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 180 mg/l

Sampling Location	Range	Average Concentration	Number of Samples Exceeding Standard
Beaches			
Winthrop Harbor	170 - 220	180	3 of 14
Zion	170 - 220	180	2 of 14
Illinois Beach State Park	170 - 200	180	3 of 14
Waukegan North	170 - 280	210	8 of 14
Waukegan Central	170 - 210	180	4 of 14
North Chicago	170 - 220	190	7 of 13
Lake Bluff	170 - 210	180	1 of 14
Lake Forest	170 - 200	180	2 of 14
Highwood	170 - 210	180	2 of 14
Highland Park-Park Ave.	170 - 230	180	2 of 14
Highland Park-Ravine Dr.	170 - 320	190	3 of 13
Highland Park-Cary Ave.	170 - 190	170	1 of 14
Glencoe	170 - 190	180	4 of 14
Winnetka	170 - 190	180	2 of 14
Kenilworth	170 - 190	180	1 of 14
Wilmette	170 - 210	180	2 of 14
Evanston	170 - 190	180	2 of 14
Chicago-Touhy Ave.	170 - 190	180	1 of 14
Chicago-Bryn Mawr Ave.	170 - 250	180	1 of 14
Chicago-Montrose Ave.	170 - 200	180	1 of 14
Chicago-North Ave.	170 - 200	180	1 of 14
Chicago-12th Street	170 - 180	170	0 of 14
Chicago-31st Street	170 - 180	170	0 of 14
Chicago-63rd Street	170 - 180	170	0 of 14
Chicago-76th Street	170 - 200	180	1 of 14
Chicago-100th Street	170 - 220	180	2 of 14
Water Plants			
Zion-Benton	170 - 190	180	2 of 17
Highland Park	170 - 200	170	2 of 19
Evanston	170 - 220	180	4 of 20
Chicago Central	160 - 190	180	3 of 20
Chicago South	170 - 230	180	3 of 19

Table 13. Gross alpha and beta emissions recorded at Lake Michigan beaches and water plants in 1974. Values are expressed in pCi/l.

Sampling Location	Samples Analyzed	Gross Alpha		Gross Beta	
		Range	Average	Range	Average
Beaches					
Winthrop Harbor	7	0.1 - 0.7	0.3	2.1 - 7.5	3.8
Zion	7	0.0 - 1.5	0.4	3.2 - 9.4	4.5
Illinois Beach State Park	7	0.0 - 0.6	0.1	2.9 - 6.9	4.0
Waukegan North	7	0.0 - 1.2	0.2	3.2 - 8.6	4.5
Waukegan Central	7	0.0 - 2.5	0.5	3.2 - 7.9	4.8
North Chicago	7	0.0 - 0.8	0.2	2.5 - 8.0	4.3
Lake Bluff	7	0.0 - 2.5	0.6	2.9 - 10.4	4.7
Lake Forest	7	0.0 - 0.7	0.2	2.3 - 9.5	4.4
Highwood	7	0.0 - 2.6	0.6	2.7 - 13.3	5.1
Highland Park-Park Ave.	7	0.0 - 1.9	0.4	2.4 - 11.9	4.7
Highland Park-Ravine Dr.	7	0.0 - 1.2	0.4	2.6 - 9.8	4.6
Highland Park-Cary Ave.	7	0.0 - 1.2	0.6	3.2 - 10.4	4.6
Glencoe	7	0.0 - 0.9	0.5	3.2 - 6.8	4.3
Winnetka	7	0.0 - 1.2	0.5	3.0 - 4.9	3.8
Kenilworth	7	0.0 - 0.9	0.4	1.6 - 4.8	3.5
Wilmette	7	0.0 - 0.3	0.1	2.3 - 5.1	3.8
Evanston	7	0.0 - 0.6	0.2	2.9 - 5.0	3.6
Chicago-Touhy Ave.	7	0.0 - 0.5	0.2	2.4 - 4.6	3.4
Chicago-Bryn Mawr Ave.	7	0.0 - 0.6	0.2	2.3 - 4.7	3.7
Chicago-Montrose Ave.	7	0.0 - 0.8	0.2	2.9 - 4.0	3.3
Chicago-North Ave.	7	0.0 - 0.8	0.3	2.4 - 3.7	3.0
Chicago-12th Street	7	0.0 - 0.6	0.2	1.7 - 3.7	2.8
Chicago-31st Street	7	0.0 - 0.4	0.1	1.2 - 4.0	3.2
Chicago-63rd Street	7	0.0 - 0.2	0.0	0.3 - 5.2	2.9
Chicago-76th Street	7	0.0 - 1.9	0.3	2.8 - 6.2	3.9
Chicago-100th Street	7	0.0 - 0.8	0.1	1.7 - 4.4	3.4
Water Plants					
Zion-Benton	9	0.0 - 0.6	0.3	2.5 - 4.2	3.5
Highland Park	11	0.0 - 1.0	0.2	2.6 - 7.1	4.0
Evanston	12	0.0 - 0.9	0.4	2.7 - 5.5	3.8
Chicago Central	12	0.0 - 0.7	0.2	1.9 - 4.9	3.4
Chicago South	11	0.0 - 1.5	0.4	1.4 - 4.9	3.4

FECAL COLIFORM

Present methods for the detection of disease producing bacteria are complex, time-consuming and are not readily amenable to routine water quality monitoring programs. The fecal coliform group of bacteria, which are non-pathogenic inhabitants of the intestinal tracts of warm-blooded animals, is closely associated with fecal and sewage discharges. This group therefore serves as a reliable indicator of recent sewage contamination. In this report fecal coliform counts have been evaluated against the annual geometric mean standard of 20/100 ml.

Annual geometric means at the beaches ranged from 3 to 84/100 ml. Three Lake County beaches had annual geometric means higher than 20/100 ml. Geometric means at the Lake and Cook County stations were 12 and 8/100 ml, respectively. The geometric mean of all samples was 10/100 ml (Table 14).

At the water plants annual geometric means ranged from 2 to 4/100 ml. The geometric mean of 94 samples was 2/100 ml.

PLANKTON

Plankton are the minute, mostly microscopic plants and animals which drift in the water subject to the action of waves and currents. Certain varieties clog filters resulting in increased costs of water treatment. Others are responsible for taste and odor problems in drinking water. In water quality monitoring, they serve to indicate eutrophication trends. In aquatic food chains, they are a primary source of food for higher organisms.

Total plankton counts at the beaches ranged from 700 to 26,300/ml. Averages by station were 2,500 to 6,000/ml. The average of all samples was 3,600/ml (Table 15).

At the water plants total plankton counts ranged from 800 to 8,400/ml. Averages by station were 2,600 to 3,500/ml. The average of 93 samples was 3,000/ml.

Table 14. Fecal coliform counts at Lake Michigan beaches and water plants in 1974. Counts are expressed as the number per 100 ml.

Standard: Geometric Mean 20/100 ml

Sampling Location	Samples Analyzed	Range	Annual Geometric Mean
Beaches			
Winthrop Harbor	14	1 - 72	9
Zion	14	1 - 140	5
Illinois Beach State Park	14	1 - 580	7
Waukegan North	14	1 - 94	7
Waukegan Central	14	1 - 1,100	7
North Chicago	13	1 - 104	3
Lake Bluff	14	1 - 230	8
Lake Forest	14	1 - 290	8
Highwood	14	1 - 8,000	27
Highland Park-Park Ave.	14	1 -38,000	84
Highland Park-Ravine Dr.	13	1 -58,000	47
Highland Park-Cary Ave.	14	2 - 5,000	17
Glencoe	14	1 - 400	17
Winnetka	14	1 - 300	9
Kenilworth	14	1 - 650	8
Wilmette	14	1 - 230	11
Evanston	14	1 - 150	8
Chicago-Touhy Ave.	14	1 - 300	14
Chicago-Bryn Mawr Ave.	13	1 - 530	9
Chicago-Montrose Ave.	14	1 - 300	9
Chicago-North Ave.	14	1 - 100	7
Chicago-12th Street	14	1 - 58	6
Chicago-31st Street	14	1 - 90	4
Chicago-63rd Street	14	1 - 3,500	6
Chicago-76th Street	14	1 - 76	4
Chicago-100th Street	14	1 - 200	16
Water Plants			
Zion-Benton	16	1 - 16	2
Highland Park	19	1 - 14	3
Evanston	20	1 - 370	4
Chicago Central	20	1 - 50	2
Chicago South	19	1 - 50	2

Table 15. Total plankton counts at Lake Michigan beaches and water plants in 1974. Counts are expressed as the number per ml.

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	13	1,600 - 4,600	2,900
Zion	14	1,500 - 8,100	3,500
Illinois Beach State Park	14	1,300 - 7,900	3,400
Waukegan North	14	1,500 - 7,500	3,000
Waukegan Central	14	1,000 - 6,900	3,100
North Chicago	13	1,600 - 5,500	3,200
Lake Bluff	13	1,200 - 4,900	2,700
Lake Forest	14	1,200 - 5,000	2,500
Highwood	14	1,200 - 4,900	2,500
Highland Park-Park Ave.	13	1,600 - 7,700	3,700
Highland Park-Ravine Dr.	13	700 - 8,800	3,200
Highland Park-Cary Ave.	14	1,200 - 6,500	2,800
Glencoe	14	1,100 - 7,500	3,200
Winnetka	14	1,200 - 5,500	3,500
Kenilworth	14	1,300 - 6,200	3,300
Wilmette	14	1,800 - 7,300	3,600
Evanston	14	1,500 - 5,600	3,600
Chicago-Touhy Ave.	14	900 -10,100	3,700
Chicago-Bryn Mawr Ave.	14	1,300 -17,100	4,900
Chicago-Montrose Ave.	14	1,500 - 9,000	4,300
Chicago-North Ave.	14	1,000 - 8,800	4,300
Chicago-12th Street	14	1,400 - 6,600	3,600
Chicago-31st Street	14	1,200 -14,600	4,400
Chicago-63rd Street	14	1,600 -14,400	4,500
Chicago-76th Street	14	1,100 - 6,800	4,100
Chicago-100th Street	14	1,500 -26,300	6,000
Water Plants			
Zion-Benton	17	1,200 - 7,500	2,900
Highland Park	18	1,300 - 7,200	3,500
Evanston	20	800 - 8,400	3,100
Chicago Central	20	1,300 - 5,800	2,600
Chicago South	18	800 - 5,200	2,700

NITRATES + NITRITES (as N)

Nitrates are the metabolic end products of organic nitrogen decomposition. They are commonly found in surface waters as a result of the decomposition of organic nitrogen in polluted streams, and from sewage effluents, agricultural runoff, cesspool leaching and industrial discharges. Nitrites in natural waters result from bacterial action upon ammonia and organic nitrogen. Because they are readily oxidized to nitrates, nitrites are not normally found in significant concentrations in surface waters. If present in sufficient concentrations in public water supplies, nitrate-nitrite may cause infant methemoglobinemia, a disease causing blood changes and cyanosis.

Nitrate-nitrite concentrations at the beaches ranged from 0.0 to 2.5 mg/l and were well below the 10 mg/l standard. Averages by station ranged from 0.2 to 0.4 mg/l, and the average of all stations was 0.3 mg/l (Table 16).

At the water plants nitrate-nitrite concentrations ranged from 0.2 to 0.8 mg/l. The average of 95 samples was 0.3 mg/l.

ALKALINITY

Alkalinity refers to the ability of water to neutralize acids. In the aquatic environment, alkalinity serves as a buffer to prevent any abrupt change in the pH of the water which might otherwise affect fish and other aquatic organisms.

Alkalinity levels at the beaches ranged from 98 to 318 mg/l. Averages by station ranged from 108 to 126 mg/l, and the average of all samples was 111 mg/l (Table 17).

At the water plants alkalinity levels ranged from 98 to 118 mg/l. Averages by station ranged from 107 to 109 mg/l, and the average of all samples was 108 mg/l.

Table 16. Nitrate and Nitrite (as N) concentrations at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Standard: 10.0 mg/l

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	14	0.0 - 0.6	0.3
Zion	14	0.2 - 0.6	0.3
Illinois Beach State Park	14	0.2 - 0.6	0.3
Waukegan North	14	0.2 - 0.6	0.3
Waukegan Central	14	0.2 - 0.8	0.3
North Chicago	13	0.2 - 0.6	0.3
Lake Bluff	14	0.2 - 0.9	0.3
Lake Forest	14	0.2 - 0.5	0.3
Highwood	14	0.2 - 0.5	0.3
Highland Park-Park Ave.	14	0.2 - 0.5	0.3
Highland Park-Ravine Dr.	13	0.2 - 0.9	0.3
Highland Park-Cary Ave.	14	0.2 - 0.5	0.3
Glencoe	14	0.2 - 2.5	0.4
Winnetka	14	0.2 - 0.4	0.2
Kenilworth	14	0.2 - 0.3	0.2
Wilmette	14	0.2 - 0.3	0.2
Evanston	14	0.1 - 0.4	0.2
Chicago-Touhy Ave.	14	0.2 - 0.4	0.2
Chicago-Bryn Mawr Ave.	14	0.2 - 0.4	0.2
Chicago-Montrose Ave.	14	0.2 - 0.4	0.2
Chicago-North Ave.	14	0.2 - 0.4	0.2
Chicago-12th Street	14	0.2 - 0.7	0.3
Chicago-31st Street	14	0.2 - 0.3	0.2
Chicago-63rd Street	14	0.2 - 0.3	0.2
Chicago-76th Street	14	0.2 - 0.3	0.2
Chicago-100th Street	14	0.2 - 0.3	0.2
Water Plants			
Zion-Benton	17	0.2 - 0.4	0.3
Highland Park	19	0.2 - 0.4	0.3
Evanston	20	0.2 - 0.5	0.3
Chicago Central	20	0.2 - 0.4	0.3
Chicago South	19	0.2 - 0.8	0.3

Table 17. Alkalinity levels recorded at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	14	108 - 128	111
Zion	14	106 - 126	110
Illinois Beach State Park	14	108 - 124	111
Waukegan North	14	108 - 140	116
Waukegan Central	14	108 - 120	110
North Chicago	13	108 - 120	112
Lake Bluff	14	108 - 318	126
Lake Forest	14	106 - 124	111
Highwood	13	106 - 122	110
Highland Park-Park Ave.	13	108 - 124	111
Highland Park-Ravine Dr.	13	108 - 172	117
Highland Park-Cary Ave.	14	108 - 152	112
Glencoe	14	98 - 136	111
Winnetka	13	106 - 136	112
Kenilworth	14	106 - 128	110
Wilmette	14	106 - 120	110
Evanston	14	106 - 122	109
Chicago-Touhy Ave.	14	106 - 120	110
Chicago-Bryn Mawr Ave.	14	106 - 114	109
Chicago-Montrose Ave.	14	106 - 120	110
Chicago-North Ave.	13	106 - 114	109
Chicago-12th Street	14	106 - 112	108
Chicago-31st Street	14	106 - 114	108
Chicago-63rd Street	14	106 - 112	108
Chicago-76th Street	14	106 - 114	108
Chicago-100th Street	14	106 - 112	108
Water Plants			
Zion-Benton	17	106 - 116	109
Highland Park	19	98 - 118	109
Evanston	20	106 - 114	109
Chicago Central	19	100 - 112	108
Chicago South	19	100 - 112	107

HEAVY METALS

Beach and water plant stations were monitored for 13 heavy metals in 1974. While many heavy metals have desirable or essential nutritional value in trace amounts, they are of concern at higher concentration because of their toxic properties. Some heavy metals are a natural component of surface waters. The presence of heavy metals in higher concentration is generally related to industrial and sewage discharges.

Measurable concentrations of barium, cadmium, nickel, and selenium were not found in 180 beach samples. Arsenic, in concentrations ranging from 0.002 to 0.012 mg/l, was found in 11 samples from five beach stations. These values were below the standard. Boron concentrations, which ranged from 0.1 to 0.2 mg/l, were well within the standard. Measurable concentrations of chromium (total) were found once each at the Waukegan North and Central beaches (both 0.02 mg/l) and at Chicago's 63rd Street beach (0.08 mg/l).Copper concentrations in two samples, with values of 0.49 mg/l (Lake Forest) and 0.05 mg/l (63rd St. beach, Chicago), exceeded the standard. Measurable iron (total) concentrations ranged from 0.1 to 8.0 mg/l with an average of 0.6 mg/l. Excessive concentrations were found in 12% of the samples. By county, 16% of the Lake and 8% of the Cook County samples contained excessive concentrations of total iron.

Lead was found in low concentrations ranging from 0.01 to 0.02 mg/l. Manganese concentrations ranged from 0.01 to 0.20 mg/l with an average of 0.02 mg/l. These values were within the standard. Three samples from the Zion (0.0006 mg/l), Glencoe (0.0006 mg/l), and Chicago, 63rd Street (0.0010 mg/l) beaches were found to have excessive concentrations of mercury. Measurable zinc concentrations were recorded in 12 samples and ranged in value from 0.1 to 0.6 mg/l. None exceeded the standard (Table 18).

At the water plants measurable concentrations of arsenic, cadmium, chromium (total), nickel, and selenium were not found in 53 samples. Barium was found once at each station at 0.1 mg/l. Measurable concentrations of boron were present in eight of 53 samples. All values were 0.1 mg/l and were below the standard. Copper in measurable concentrations was found in eight of 53 samples. The concentration of copper in seven samples was 0.01 mg/l and one sample yielded a concentration of 0.02 mg/l. Iron (total) concentrations in excess of the standard were found in 12 of 53 samples. These 12 samples were from the Zion-Benton, Highland Park and Evanston stations and ranged in concentration from 0.4 to 0.9 mg/l.

Measurable lead concentrations were found in four of 53 samples and ranged in value from 0.01 to 0.02 mg/l. None exceeded the standard. Manganese concentrations higher than the standard were found in three samples. These values were 0.06, 0.07, and 0.08 mg/l and represented 6% of the samples from the water plants. Mercury was found once each at the four southernmost stations and ranged in value from 0.0002 to 0.0004 mg/l. The standard for mercury is 0.0005 mg/l. Zinc was found in low amounts in nine of 53 samples. Values ranged from 0.1 to 0.6 mg/l (Table 19).

Table 18. Heavy metal concentrations in Lake Michigan shore water during 1974. Concentrations are expressed in mg/l.

Heavy Metal	Standard	Samples Analyzed	Range	Average
Arsenic	1.0	180	0.000 - 0.012	0.000
Barium	5.0	180	0.0 - 0.0	0.0
Boron	1.0	180	0.0 - 0.2	0.0
Cadmium	0.05	180	0.00 - 0.00	0.00
Chromium (Total)	1.05	180	0.00 - 0.08	0.00
Copper	0.02	180	0.00 - 0.49	0.00
Iron (Total)	1.0	180	0.0 - 8.0	0.6
Lead	0.1	180	0.00 - 0.02	0.00
Manganese	1.0	180	0.00 - 0.20	0.02
Mercury	0.0005	180	0.0000- 0.0010	0.0001
Nickel	1.0	180	0.0 - 0.0	0.0
Selenium	1.0	180	0.00 - 0.00	0.00
Zinc	1.0	180	0.0 - 0.6	0.0

Table 19. Heavy metal concentrations recorded at intakes of five municipal water filtration plants in 1974. Concentrations are expressed in mg/l.

Heavy Metal	Standard	Samples Analyzed	Range	Average
Arsenic	0.01	53	0.000 - 0.000	0.000
Barium	1.0	53	0.0 - 0.1	0.0
Boron	1.0	53	0.0 - 0.1	0.0
Cadmium	0.01	53	0.00 - 0.00	0.00
Chromium (Total)	1.05	53	0.00 - 0.00	0.00
Copper	0.02	53	0.00 - 0.02	0.00
Iron (Total)	0.3	53	0.0 - 0.9	0.2
Lead	0.05	53	0.00 - 0.02	0.00
Manganese	0.05	53	0.00 - 0.08	0.01
Mercury	0.0005	53	0.0000 - 0.0004	0.0000
Nickel	1.0	53	0.0 - 0.0	0.0
Selenium	0.01	53	0.00 - 0.00	0.00
Zinc	1.0	53	0.0 - 0.1	0.0

HARDNESS

Hard water forms scales in boilers, heaters, radiators and pipes, and is responsible for increased consumption of soap and detergents. In the aquatic environment, hard waters have been shown to reduce the detrimental effects of toxic metals on aquatic life.

Hardness levels at the beaches ranged from 130 to 220 mg/l. Averages by station ranged from 130 to 150 mg/l, and the average of all samples was 130 mg/l (Table 20).

At the water plants hardness levels ranged from 120 to 150 mg/l. The average level at each station was 130 mg/l.

COLOR

Color in water may result from the presence of various natural substances and industrial wastes. It is aesthetically undesirable and may pose problems for some industrial users.

Color levels at the beaches ranged from 2 to 44 units, and the average of all samples was 2 units (Table 21). At the water plants color levels ranged from 1 to 6 units, and the average of all samples was 2 units.

CHEMICAL OXYGEN DEMAND (COD)

Organic matter found in water undergoes various degrees of oxidation in the presence of strong, boiling acids. The chemical oxygen demand test measures, as oxygen equivalent, the oxidizable portion of the organic matter.

COD levels at the beaches ranged from 4 to 68 mg/l. Averages by station ranged from 11 to 17 mg/l. The average of all samples was 13 mg/l (Table 22).

At the water plants COD levels ranged from 1 to 24 mg/l. Averages by station ranged from 10 to 12 mg/l, and the average of all samples was 11 mg/l.

Table 20. Hardness levels recorded at Lake Michigan beaches and water plants in 1974. Concentrations are expressed in mg/l.

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	14	130 - 160	140
Zion	14	130 - 160	140
Illinois Beach State Park	14	130 - 150	140
Waukegan North	14	130 - 200	150
Waukegan Central	14	130 - 160	140
North Chicago	13	130 - 160	140
Lake Bluff	14	130 - 160	140
Lake Forest	14	130 - 150	140
Highwood	14	130 - 160	140
Highland Park-Park Ave.	14	130 - 150	140
Highland Park-Ravine Dr.	13	130 - 220	140
Highland Park-Cary Ave.	14	130 - 150	130
Glencoe	14	130 - 150	130
Winnetka	13	130 - 150	130
Kenilworth	14	130 - 150	130
Wilmette	14	130 - 140	130
Evanston	14	130 - 140	130
Chicago-Touhy Ave.	14	130 - 140	130
Chicago-Bryn Mawr Ave.	14	130 - 140	130
Chicago-Montrose Ave.	14	130 - 140	130
Chicago-North Ave.	13	130 - 140	130
Chicago-12th Street	14	130 - 140	130
Chicago-31st Street	14	130 - 140	130
Chicago-63rd Street	14	130 - 140	130
Chicago-76th Street	14	130 - 150	130
Chicago-100th Street	14	130 - 140	130
Water Plants			
Zion-Benton	17	130 - 150	130
Highland Park	19	130 - 140	130
Evanston	20	130 - 140	130
Chicago Central	19	120 - 140	130
Chicago South	19	130 - 140	130

Table 21. Color levels at Lake Michigan beaches and water plants in 1974. Values are expressed in color units.

Sampling Location	Samples Analyzed	Range	Average
Beaches			
Winthrop Harbor	14	2 - 3	2
Zion	13	2 - 3	2
Illinois Beach State Park	13	2 - 4	2
Waukegan North	14	2 -11	4
Waukegan Central	14	2 - 7	2
North Chicago	13	2 - 7	2
Lake Bluff	14	2 - 5	2
Lake Forest	13	2 - 4	2
Highwood	14	2 - 8	2
Highland Park-Park Ave.	14	2 - 7	2
Highland Park-Ravine Dr.	13	2 -44	5
Highland Park-Cary Ave.	14	2 - 7	2
Glencoe	14	2 - 7	2
Winnetka	13	2 - 5	2
Kenilworth	14	2 - 5	2
Wilmette	14	2 - 4	2
Evanston	14	2 - 5	2
Chicago-Touhy Ave.	14	2 - 4	2
Chicago-Bryn Mawr Ave.	14	2 - 5	2
Chicago-Montrose Ave.	14	2 - 7	3
Chicago-North Ave.	13	2 - 4	3
Chicago-12th Street	13	2 - 9	3
Chicago-31st Street	14	2 - 4	2
Chicago-63rd Street	13	2 - 7	2
Chicago-76th Street	14	2 - 2	2
Chicago-100th Street	14	2 - 4	2
Water Plants			
Zion-Benton	17	2 - 3	2
Highland Park	19	2 - 4	2
Evanston	20	2 - 4	2
Chicago Central	19	2 - 6	2
Chicago South	19	1 - 5	2

Table 22. Chemical oxygen demand (COD) levels recorded at Lake Michigan beaches and water plants in 1974. Values are expressed in mg/l.

Sampling Location	Samples Analyzed	Range	Average Concentration
Beaches			
Winthrop Harbor	14	7 - 20	12
Zion	14	8 - 21	13
Illinois Beach State Park	14	8 - 20	12
Waukegan North	14	7 - 68	17
Waukegan Central	14	7 - 23	14
North Chicago	13	6 - 29	13
Lake Bluff	14	6 - 20	14
Lake Forest	14	8 - 24	14
Highwood	14	5 - 26	14
Highland Park-Park Ave.	14	5 - 23	13
Highland Park-Ravine Dr.	13	5 - 23	14
Highland Park-Cary Ave.	14	4 - 24	12
Glencoe	14	4 - 18	11
Winnetka	14	4 - 20	12
Kenilworth	14	4 - 18	12
Wilmette	14	4 - 18	12
Evanston	14	5 - 23	12
Chicago-Touhy Ave.	14	4 - 22	12
Chicago-Bryn Mawr Ave.	14	4 - 20	12
Chicago-Montrose Ave.	14	5 - 20	12
Chicago-North Ave.	14	5 - 24	12
Chicago-12th Street	14	6 - 25	12
Chicago-31st Street	14	6 - 19	12
Chicago-63rd Street	14	5 - 21	12
Chicago-76th Street	14	5 - 20	12
Chicago-100th Street	14	6 - 22	12
Water Plants			
Zion-Benton	17	4 - 24	12
Highland Park	19	2 - 20	11
Evanston	20	5 - 23	12
Chicago Central	20	1 - 18	10
Chicago South	19	4 - 21	11

SPECIAL SAMPLING

GENERAL INFORMATION

Potentially harmful contaminants have been found in Lake Michigan water. These include the chlorinated hydrocarbon pesticides, polychlorinated biphenyls, phthalates and heavy metals. Heavy metals in Lake Michigan water are discussed in an earlier portion of this report. Monitoring programs by the Lake Michigan States are presently underway and are being conducted as much as practicable to follow recommendations of the Lake Michigan Toxic Substances Committee.

Polychlorinated biphenyls (PCB's) have beer identified in Lake Michigan water, sediment and fish. PCB's, which are extremely persistent chlorinated hydrocarbons, have been found to accumulate through food chains of fish and birds, and may have an effect on reproductive potential of these as well as other forms of wildlife. PCB's are used in the production of adhesives, asphalt, elastomers, electrical insulation, fire-resistant heat transfer and hydraulic fluids, special lubricants, sealants and expansion media, synthetic rubber, floor tile, printers ink, coatings for paper and fabrics, pigments, resin, paints, varnishes and waxes.

Phthalates are chemical compounds of recent environmental concern. They are used as plasticizers in the plastics industry, particularly in the production of polyvinyl chloride plastics. Two phthalate esters, DOP di (2-ethylhexyl) phthalate and DBP (di-n-butyl phthalate), have been encountered sporatically in some sewage effluents and streams tributary to Lake Michigan.

RESULTS OF MONITORING

PESTICIDES, POLYCHLORINATED BIPHENYLS AND PHTHALATES

WATER SAMPLES

A total of forty-one water samples were collected at Kellogg Creek, the Waukegan River, Pettibone Creek, and the North Shore Sanitary District sewage treatment plants at North Chicago and Waukegan (Tables 23 and 24).

Since 1972 six parameters have been analyzed for including heptachlor epoxide, dieldrin, di (2-ethylhexyl) phthalate, total DDT, Aroclor 1242 and Aroclor 1254. Over the three year period the only indicated trend has been an apparent increase in Aroclor 1242 concentrations measured at the sewage treatment plants and a decrease in Aroclor 1254 measured at stream sampling stations. Concentrations of heptachlor epoxide, dieldrin, di (2-ethylhexyl) phthalate, and total DDT appear at similar concentrations.

Maximum concentrations of most parameters were found at the sewage treatment plants. The North Shore Sanitary District plant at Waukegan recorded high values for heptachlor epoxide (24.0 ppt), dieldrin (60.0 ppt), and Aroclor 1254 (180.0 ppt). The North Shore Sanitary District plant at North Chicago

Table 23. Pesticides, PCB's and phthalates found in effluents of sewage treatment plants tributary to Lake Michigan in 1974. Concentrations are expressed as parts per trillion (ppt).

Location	Date Collected	Heptachlor Epoxide	Dieldrin	Phthalates (1) DOP	o,p' Isomers DDE	o,p' Isomers DDD	o,p' Isomers DDT	p,p' Isomers DDE	p,p' Isomers DDD	p,p' Isomers DDT	Total DDT	Aroclor 1242	Aroclor 1254
NSSD Waukegan STP	2/6/74	ND	3.0	1500.0	ND	ND	ND	12.0	ND	23.0	35.0	1180.0	180.0
NSSD Waukegan STP	3/6/74	ND	9.0	(3)	ND	ND	ND	ND	22.0	58.0	80.0	900.0	180.0
NSSD Waukegan STP	4/9/74	ND	60.0	ND	ND	ND	4.0	15.0	4.0	17.0	40.0	820.0	80.0
NSSD Waukegan STP	5/7/74	ND	8.0	130.0	ND	ND	ND	1.0	6.0	32.0	39.0	460.0	54.0
NSSD Waukegan STP	8/6/74	4.0	9.0	1850.0	ND	ND	ND	5.0	9.0	21.0	35.0	250.0	100.0
NSSD Waukegan STP	9/10/74	ND	50.0	1530.0	ND	ND	ND	3.0	48.0	64.0	115.0	840.0	90.0
NSSD Waukegan STP	10/9/74	18.0	2.0	1500.0	ND	ND	ND	11.0	9.0	40.0	60.0	120.0	20.0
NSSD Waukegan STP	11/5/74	24.0	23.0	3800.0	ND	ND	ND	7.0	14.0	36.0	57.0	1140.0	130.0
NSSD No. Chicago STP	2/6/74	2.0	8.0	1200.0	ND	ND	ND	12.0	ND	22.0	35.0	2110.0	150.0
NSSD No. Chicago STP	3/6/74	ND	20.0	(3)	ND	ND	ND	8.0	20.0	75.0	103.0	ND	110.0
NSSD No. Chicago STP	4/9/74	< 1.0	5.0	ND	ND	ND	4.0	14.0	2.0	5.0	25.0	1000.0	69.0
NSSD No. Chicago STP	5/7/74	ND	51.0	210.0	ND	ND	18.0	12.0	9.0	101.0	140.0	560.0	64.0
NSSD No. Chicago STP	6/4/74	2.0	12.0	1600.0	ND	ND	ND	5.0	12.0	10.0	27.0	1030.0	110.0
NSSD No. Chicago STP	8/6/74	6.0	21.0	3350.0	ND	ND	ND	5.0	6.0	103.0	114.0	590.0	120.0
NSSD No. Chicago STP	9/10/74	1.0	10.0	520.0	ND	ND	ND	5.0	4.0	16.0	25.0	240.0	100.0
NSSD No. Chicago STP	10/9/74	6.0	5.0	4000.0	ND	ND	ND	1.0	5.0	23.0	38.0	250.0	20.0
NSSD No. Chicago STP	11/5/74	2.0	11.0	2500.0	ND	ND	ND	2.0	7.0	119.0	128.0	890.0	70.0

(1) DOP = di(2 - ethylhexyl) phthalate

(2) ND = Not Detected

(3) Present but not quantified due to interference.

Table 24. Pesticides, PCB's and phthalates found in waters from Illinois streams tributary to Lake Michigan in 1974. Concentrations are expressed in parts per trillion, (ppt).

				Phthalates	o,p' Isomers			p,p' Isomers				Aroclor	
Location	Date Collected	Heptachlor Epoxide	Dieldrin	(1) DOP	DDE	DDD	DDT	DDE	DDD	DDT	Total DDT	1242	1254
Kellogg Creek	2/4/74	ND	3.0	ND	ND	ND	ND	5.0	ND	8.0	13.0	ND	54.0
Kellogg Creek	4/10/74	2.0	4.0	ND	ND	ND	ND	14.0	3.0	20.0	37.0	460.0	50.0
Kellogg Creek	5/7/74	9.0	7.0	ND	ND	ND	ND	7.0	ND	26.0	33.0	ND	140.0
Kellogg Creek	7/8/74	1.0	2.0	ND	ND	ND	ND	4.0	13.0	20.0	37.0	165.0	ND
Kellogg Creek	8/5/74	5.0	5.0	ND	ND	ND	ND	ND	12.0	72.0	84.0	110.0	60.0
Kellogg Creek	9/9/74	3.0	10.0	ND	ND	ND	ND	5.0	8.0	11.0	29.0	100.0	50.0
Kellogg Creek	10/7/74	6.0	5.0	ND	ND	ND	ND	3.0	8.0	13.0	24.0	150.0	<20.0
Kellogg Creek	11/27/74	10.0	39.0	120.0	ND	ND	ND	7.0	3.0	28.0	38.0	410.0	20.0
Waukegan River	2/4/74	2.0	4.0	ND	ND	ND	ND	6.0	2.0	9.0	17.0	390.0	90.0
Waukegan River	3/6/74	3.0	1.0	ND	ND	ND	14.0	5.0	ND	17.0	36.0	ND	97.0
Waukegan River	5/7/74	ND	6.0	280.0	ND	ND	ND	6.0	2.0	1.0	9.0	ND	41.0
Waukegan River	7/8/74	1.0	ND	ND	ND	ND	5.0	ND	16.0	265.0	286.0	ND	38.0
Waukegan River	8/5/74	4.0	4.0	ND	ND	ND	ND	8.0	7.0	12.0	27.0	150.0	50.0
Waukegan River	9/9/74	2.0	5.0	ND	ND	ND	ND	4.0	13.0	61.0	78.0	170.0	90.0
Waukegan River	10/7/74	4.0	2.0	ND	ND	ND	ND	2.0	6.0	9.0	17.0	120.0	<20.0
Waukegan River	11/27/74	8.0	3.0	330.0	ND	ND	ND	8.0	7.0	9.0	24.0	500.0	30.0
Pettibone Creek	3/6/74	2.0	4.0	ND	ND	ND	12.0	ND	ND	13.0	25.0	ND	120.0
Pettibone Creek	4/10/74	2.0	<1.0	ND	ND	ND	ND	10.0	4.0	13.0	27.0	320.0	40.0
Pettibone Creek	5/7/74	5.0	<1.0	ND	ND	ND	ND	10.0	ND	30.0	40.0	ND	ND
Pettibone Creek	7/8/74	1.0	7.0	ND	ND	ND	8.0	ND	8.0	13.0	29.0	120.0	ND
Pettibone Creek	8/5/74	4.0	19.0	ND	ND	ND	ND	3.0	19.0	25.0	47.0	250.0	50.0
Pettibone Creek	9/9/74	2.0	5.0	ND	ND	ND	ND	4.0	13.0	61.0	78.0	170.0	90.0
Pettibone Creek	10/7/74	4.0	8.0	ND	ND	ND	ND	8.0	18.0	38.0	64.0	120.0	<20.0
Pettibone Creek	11/27/74	3.0	2.0	160.0	ND	ND	ND	6.0	66.0	10.0	82.0	ND	40.0

(1) DOP = di(2 - ethylhexyl) phthalate

(2) ND = Not Detected

recorded high values for di (2-ethylhexyl) phthalate (4000.0 ppt) and Aroclor 1242 (2110.0 ppt). The maximum concentration of total DDT, 286.0 ppt, was recorded at the Waukegan River. A continuous monitoring program will be needed to determine an increase or decrease in concentrations of these parameters.

FISH SAMPLES

Analyses of fish samples by this Agency are directed toward the determination of environmental contamination by various contaminants. The data included in this report and the reference to various recommended standards should not be used for questions relating to public health. Fish samples analyzed were obtained from an edible fillet for all species in this report. For fish smaller than one pound, most of the edible portion was used. For fish larger than one pound, a dorsal fillet was obtained from immediately behind the gill cover and above the lateral line. The sample fillet collected in most cases was approximately one pound for the larger fish.

The Technical Committee on Pesticides established by the Lake Michigan Enforcement Conference recommended that the concentrations of pesticides in fish should not exceed 1.0 parts per million DDT, 0.5 parts per million DDD, 0.1 parts per million dieldrin, and that all other chlorinated hydrocarbon pesticides, singly or combined, should not exceed 0.1 parts per million based on the wet weight of the tissue sampled. The U.S. Food and Drug Administration has established a 5.0 ppm action level on both DDT and polychlorinated biphenyls.

A total of 40 fish were collected in 1974 and analyzed for total DDT, polychlorinated biphenyls, dieldrin, and heptachlor epoxide (Table 25). The fish species analyzed included chinook salmon, brown trout, lake trout, carp, northern pike, largemouth bass and smallmouth bass.

Polychlorinated biphenyl concentrations continued to be high and varied considerably between species. Lake trout contained the highest concentrations of PCB's with a maximum value of 29.2 ppm. All ten lake trout analyzed were in excess of the 5.0 ppm guideline for PCB's. Highest concentrations of total DDT were also found in the lake trout samples in which six out of ten fish had values of 5.0 ppm or greater. In 15 chinook salmon, 5 fish had PCB concentrations greater than 5.0 ppm while all DDT values were less than 5.0 ppm. Six northern pike samples had values of total PCB and total DDT all below the 5.0 ppm guideline. A limited number of carp, bass, and brown trout showed values of total PCB and total DDT below 5.0 ppm with only one exception. Concentrations of heptachlor epoxide for all species were 0.1 ppm or less while dieldrin ranged from less than 0.1 to 0.2 ppm.

Table 25. Pesticides and PCB's found in the edible portions of seven species of Lake Michigan fish in 1974. Concentrations are expressed in parts per million (ppm) on a wet weight basis.

Species	Number and Sex Analyzed	Size in Inches	Sample Location	Date Collected	Heptachlor Epoxide	Dieldrin	Total DDT	Total PCB's
Chinook Salmon	1 Male	29.5	Chicago	10-9-74	<0.1	0.2	3.5	6.8
Chinook Salmon	1 Male	32.0	Chicago	10-9-74	<0.1	<0.1	2.2	4.8
Chinook Salmon	1 Male	29.5	Chicago	10-9-74	<0.1	<0.1	1.8	5.1
Chinook Salmon	1 Male	30.5	Chicago	10-9-74	ND	0.1	3.8	6.0
Chinook Salmon	1 Male	23.0	Chicago	10-9-74	<0.1	<0.1	1.9	2.0
Chinook Salmon	1 Male	23.5	Chicago	10-9-74	<0.1	0.1	1.8	4.6
Chinook Salmon	1 Male	22.5	Chicago	10-9-74	ND	<0.1	2.4	5.4
Chinook Salmon	1 Male	24.0	Chicago	10-9-74	<0.1	0.2	1.0	3.5
Chinook Salmon	1 Female	31.0	Chicago	10-9-74	ND	0.1	2.7	3.2
Chinook Salmon	1 Female	19.5	Chicago	10-9-74	ND	<0.1	1.8	2.8
Chinook Salmon	1 Female	37.0	North Chicago	10-22-74	<0.1	<0.1	4.3	13.3
Chinook Salmon	1 ------	23.5	Chicago	9-16-74	<0.1	0.1	1.1	2.1
Chinook Salmon	1 Male	19.5	Chicago	9-17-74	<0.1	<0.1	0.8	1.4
Chinook Salmon	1 Male	21.0	Chicago	9-17-74	<0.1	<0.1	0.5	2.1
Chinook Salmon	1 Male	21.5	Chicago	9-17-74	<0.1	<0.1	0.5	2.2
Northern Pike	1 Male	23.5	North Chicago	10-22-74	<0.1	<0.1	1.6	2.9
Northern Pike	1 Female	22.0	North Chicago	10-22-74	ND	<0.1	1.1	1.7
Northern Pike	1 Female	23.5	North Chicago	10-22-74	<0.1	<0.1	1.1	3.6
Northern Pike	1 Female	23.5	North Chicago	10-22-74	<0.1	<0.1	0.7	3.3
Northern Pike	1 Female	22.5	North Chicago	10-22-74	ND	<0.1	0.8	2.0
Northern Pike	1 ------	23.5	North Chicago	10-22-74	ND	0.1	0.9	3.0
Lake Trout	1 Female	25.0	North Chicago	10-22-74	<0.1	0.2	2.9	17.3
Lake Trout	1 Male	24.0	North Chicago	10-22-74	ND	0.2	6.0	9.1
Lake Trout	1 Female	24.0	North Chicago	10-22-74	0.1	0.2	4.7	9.7
Lake Trout	1 Male	26.5	North Chicago	10-22-74	<0.1	0.1	6.4	12.5
Lake Trout	1 Female	27.5	North Chicago	10-22-74	0.1	0.1	7.2	16.9
Lake Trout	1 Female	24.0	North Chicago	10-22-74	0.1	0.1	3.2	14.2
Lake Trout	1 Male	25.5	North Chicago	10-22-74	0.1	<0.1	7.5	10.7
Lake Trout	1 Male	22.5	North Chicago	10-22-74	0.1	<0.1	5.0	13.8
Lake Trout	1 Female	24.5	North Chicago	10-22-74	<0.1	0.1	4.2	7.8
Lake Trout	1 Male	24.5	North Chicago	10-22-74	ND	0.1	5.6	29.2
Carp	1 ------	22.5	Chicago	9-16-74	0.1	0.2	1.2	7.4
Carp	1 ------	21.0	Chicago	9-16-74	<0.1	<0.1	0.2	0.7
Carp	1 ------	21.5	Chicago	9-16-74	<0.1	0.1	2.8	3.8
Carp	1 ------	23.0	Chicago	9-16-74	<0.1	<0.1	1.3	2.9
LM Bass	1 Female	12.5	Chicago	9-16-74	<0.1	0.1	0.6	1.3
LM Bass	1 ------	11.5	Chicago	9-16-74	<0.1	<0.1	0.5	1.0
SM Bass	1 Female	15.0	Chicago	9-16-74	<0.1	0.1	1.0	2.5
Brown Trout	1 Male	18.5	Chicago	9-16-74	<0.1	0.1	1.3	2.3
Brown Trout	1 Male	18.5	Chicago	9-16-74	<0.1	0.1	1.3	2.7

ND = Not Detected

ILLINOIS DISCHARGES

WATER PLANT WASTE

The Water Pollution Regulations, adopted by the Pollution Control Board in 1972, extended the deadline for the elimination of backwash water discharges from water filtration plants. The extended deadline for compliance was December 31, 1974.

Additionally, water plants were required to discontinue the practice of flushing settling basin sludge into the lake by July 1972. In general, those municipalities which have not met the compliance dates are preparing plans for the elimination of these discharges.

M.S.D.G.C. OVERFLOWS

All of the lake shore municipalities in Cook County (Glencoe through Chicago) are served by the Metropolitan Sanitary District of Greater Chicago. Except for several surface drains, no sewers within the jurisdiction of the District discharge directly to Lake Michigan. The District's three major sewage treatment plants and combined sewers (sewage and storm water) discharge to a system of waterways which are tributary to the DesPlaines River. The waterways receive flow from Lake Michigan regulated by facilities at Wilmette, Chicago River locks, and the O'Brien lock on the Calumet River.

Lock and dam facilities prevent back-flow of contaminated river water into Lake Michigan. Heavy rains may cause such heavy discharge to these waterways that the water level rises above the level of the lake resulting in back-flow through the locks and overflow of the dams. Therefore, the District maintains an alert system with the Lockport control facilities. Whenever heavy rain is predicted, the Lockport Dam lowers the water level in the rivers and thereby prevents or minimizes the discharge from the MSDGC waterways to Lake Michigan.

The following list indicates the dates on which reverse flows occurred over the past six years:

1974	None
1973	None
1972	June 14, August 26, September 17
1971	None
1970	None
1969	October 10

ILLINOIS DISCHARGES

SEWAGE

NORTH SHORE SANITARY DISTRICT Two municipal sewage treatment plants discharge to the Illinois portion of Lake Michigan. They are operated by the North Shore Sanitary District and are located in Waukegan and North Chicago. Effluents from sewage plants at Lake Bluff, Lake Forest and three in Highland Park were eliminated during 1974. During periods of wet weather the Lake Bluff and Lake Forest plants will have a discharge to Lake Michigan until a new plant in Gurnee and a new interceptor sewer are completed.

The North Shore Sanitary District is now engaged in an extensive construction program which will divert the remaining sewage effluents from the Lake Michigan watershed. The North Chicago sewage treatment plant effluent will be diverted to the new facility to be located in Gurnee (DesPlaines River watershed) by late 1975. Advanced treatment will be provided at the Waukegan sewage treatment plant. The effluent from the Waukegan plant will then be pumped for discharge to the DesPlaines River. Phosphorus reduction facilities are now in operation at the Waukegan and North Chicago plants. Sewer bypasses at Gillette and Water Streets in Waukegan were eliminated in late 1974.

MILITARY INSTALLATIONS The Great Lakes Naval Training Center and the Army's Fort Sheridan operate sewage treatment plants providing secondary treatment.

The Navy has completed negotiations to divert their flows to the North Shore Sanitary District. The diversion must await the completion of the new facility at Gurnee. During the interim, the Navy has employed the addition of polymer and ferric chloride to improve their effluent quality and comply with the phosphorus regulations.

The sewage treatment plant at Fort Sheridan is currently operating at less than the design capacity, due to the transferring of Fifth Army Headquarters. The base is expected to connect to the NSSD in late 1976. No interim measures for phosphorus reduction have, as yet, been implemented.

ILLINOIS DISCHARGES

INDUSTRIAL WASTE

ABBOTT LABORATORIES (Manufacturers of drugs, antibiotics and pharmaceuticals). Abbott operates a waste treatment plant which provides secondary treatment of their extremely strong industrial waste. Until the North Shore Sanitary District's new facilities are completed at Gurnee, Abbott will continue to mix their effluent with their cooling water discharge. This reduces the impact of the waste at the point of discharge and causes the effluent to be, generally, in compliance with the standard. When the N.S.S.D. project is completed, Abbott will discharge only cooling water to Lake Michigan.

COMMONWEALTH EDISON COMPANY, WAUKEGAN STATION (Fossil fuel electric generating station). This plant has been operating since 1927. At full capacity, the maximum temperature rise through the condensers is 12°F. Extensive studies of the thermal plume on the localized portion of the lake have identified no adverse effects.

COMMONWEALTH EDISON COMPANY, ZION STATION (Nuclear fuel electric generating station). Portions of this facility were completed in 1972. At full capacity, the maximum temperature rise through the condensers is not expected to exceed 20°F. The Illinois Pollution Control Board has authorized the facility to utilize Lake Michigan for cooling, providing all the requirements listed in the thermal regulations are met.

FANSTEEL INCORPORATED (Producers of corrosion-resistant metals used for electrical and chemical applications). During 1974, Fansteel completed special pretreatment facilities which made possible the elimination of the only remaining discharge of process waste. Cooling water will continue to be discharged to Pettibone Creek.

JOHNSON MOTORS, DIVISION OF OUTBOARD MARINE CORPORATION (Manufacturers of outboard motors). Johnson Motors has several discharges of cooling water and process wastes to Waukegan harbor and through a ditch to Lake Michigan, several hundred yards north of Waukegan's North Beach. Metals concentrations are generally within the state guidelines. Oil in the discharges is usually contained by oil separators or barriers and baffles which cross the effluent ditch.

UNITED STATES STEEL CORPORATION, WAUKEGAN WORKS (Producers of stainless and carbon steel wire and springs). In-plant improvements and acid waste hauling for deep well disposal in Gary, Indiana, have resulted in major reduction of acid and metals discharged from this facility. The present discharge via several outfalls exceeds the state's effluent guidelines. Litigation concerning compliance with effluent and water quality standards is pending.

UNITED STATES STEEL CORPORATION, SOUTH WORKS (Steel smelting plant). This plant presently has outfalls discharging to Lake Michigan and the Calumet River. A court order issued January 18, 1971, requires a closed cycle system by 1975. By late 1974 recycle of all process waste waters has partially been attained and is on schedule for the 1975 completion date.

UNIVERSITY OF ILLINOIS-URBANA
3 0112 084227948